Astronomy Reports 2013 vol.57 N6, pages 410-422

Modeling and analysis of the spectrum of the globular cluster NGC 2419

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Abstract

The properties of the stellar population of the unusual object NGC 2419 are studied; this is the most distant high-mass globular cluster of the Galaxy's outer halo, and a spectrum taken with the 1.93-m telescope of the Haute Provence Observatory displays elemental abundance anomalies. Since traditional high-resolution spectroscopicmethods are applicable to bright stars only, spectroscopic information for the cluster's stellar population as a whole, integrated along the spectrograph slit placed in various positions, is used. Population synthesis is carried out for the spectrum of NGC 2419 using synthetic spectra calculated from a grid of stellar model atmospheres, based on the theoretical isochrone from the literature that best fits the color-magnitude diagram of the cluster. The derived age (12.6 billion years), metallicity ([Fe/H] = -2.25 dex), and abundances of helium (Y = 0.26) and other chemical elements (a total of 14) are in a good qualitative agreement with estimates from the literature made from high-resolution spectra of eight red giants in the cluster. The influence on the spectrum of deviations from local thermodynamic equilibrium is considered for several elements. The derived abundance of α-elements ([α/Fe] = 0.13 dex, as the mean of [O/Fe], [Mg/Fe], and [Ca/Fe]) differs from the mean value in the literature ([α/Fe] = 0.4 for the eight brightest red giants) and may be explained by recently discovered in NGC2419 large [a/Fe] dispersion. Further studies of the integrated properties of the stellar population in NGC 2419 using higher-resolution spectrographs in various wavelength ranges should help improve our understanding of the cluster's chemical anomalies.

http://dx.doi.org/10.1134/S1063772913060061